# TWO DIMENSIONAL KINEMATICS ANALYSIS OF SLAP SHOT IN FIELD HOCKEY

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# Chapter-I

## Introduction

A detailed examination of skillful performance and an evaluation of the utility of its attributes are essential when trying to boost athletic performance. The end effectors (such as the hand, foot, stick, club, etc.) are typically accelerated by highly experienced athletes, according to several researchers who have researched explosive throwing, striking, and kicking skills in this way. The Slap Shot skill is unique shot that may be used for shots on goal as well as an offensive strategy during free throws and P.C. It can produce goals when the defense carried them out well. The slap shot requires intricate movement of the body. When a player slaps another player in hockey, their body moves in the manner shown below: This stroke is mostly used for playing long-range, diagonal, parallel, and back passes in the defensive and attractive area. Sharp passes are played into the shooting circle within the 23mt area and from behind also. This stroke is also played in the midfield to pass each other for making attacks. This is most sharp stroke to send the ball one side to other side, from one corner to another corner quickly Slap shot technique needs to be better understood, and hence 2D and 3D analysis is needed. There is limited evidence available about how a player's movement speed influences his accuracy in one specific area. An exercise as simple as a hockey slap shot has seen comparatively few attempts to track changes in motor function throughout the continuous engagement. The slapshot has only been examined in a small number of research. Some of them have offered kinematical details on precisely defined elements of the slapshot method.

The slap shot skill is stronger and faster for hitting the ball than a push pass. One of the more thrilling plays in a hockey game is the slap shot because you can watch the entire sequence play out: the player setting their feet; the massive, dramatic backswing; and the loud impact of the stick with the ice and the ball. But a lot of things need to go right for that shot to be as quick and accurate as possible. A successful slap shot is the result of precise mechanics, body positioning, and weight transfer—none of which come naturally—just like a long golf drive. Practice a lot and pay attention to the individual steps in the procedure, to create a strong slapper. Here are five points to pay attention to. Hockey, indoor hockey and ice hockey are the three game types that are most popular in the sport of hockey. Consisting of one custodian and ten field players, a total of 11 individuals participated. Several of the fundamental strategies employed in this game are well recognized. The fundamental moves include dribbling, rolling, dribbling and passing, as well as push passes, slap shots, straight

hits, reverse hits, various scoops, drags, and flicks.[1] To collect information for their exploratory investigation, the researchers utilized a technique that involved downloading a video of a hockey game from YouTube. Observations regarding the Australia vs. India Hockey World Cup Download 2014 match and the Australia vs. Netherlands championship game. The Sultan Azlan Shah Cup 2017's third match included Australia playing India, Malaysia playing Australia, and Japan playing Malaysia. From the match's results, observations were made regarding five techniques that were frequently used: result push, which was used on average 357 times per game, slap hit, which was used 140 times per match, reverse hit, which was used 50 times per game, scope, which was used 35 times per game, and hit, which was used 23 times on average. Keep in mind that you should be striking the ball with base of the shaft rather than the hook's end. Your leading leg's knee should be fully bent. Your toe should be pointing roughly 90 degrees away from the intended ball-striking location. Keeping low and keeping their sticks virtually parallel to the ground is a specialty of pros. Always carry out your plans while keeping an eye on your target. I had to practice my technique to be able to stroke the ball forcefully and precisely. You eventually iron out your style's kinks. I became aware that I was slapping too upright and lacked sufficient force. Observe how foreign players execute the slapping pass. They set their bodies in a very low position with their sticks almost parallel to the ground and always follow through. [2]

## Statement of the Problem

Statement of problem is Two-dimensional kinematic analysis of slap shots in field hockey.

## Rational of the Study

I. The study will help to correct the technique of the skill.
II. Through biomechanical analysis, we can improve player performance.

## Objective of Study

The research objective of the proposed research are as follows:

I. To investigate the relationship between hockey specific skill slap shots and kinematic variables in field hockey.

## Delimitations

I. The study will only focus on female hockey players competing at the open national level.
II. The age range of the subjects for this study will be 17 to 28.
III. The study will be further restricted to just three Slap shot tries.

IV. The investigation will also be restricted to the execution stage.

The following variables are selected:

**Linear kinematic:**

I. CG- the center of gravity

II. BV- Ball velocity

**Angular kinematics**

I. Angle of the ankle joint (L/R)

II. Angle of the knee joint (L/R)

III. Hip joint angle

IV. Shoulder joint angle (right)

V. Elbow joint angle (L/R)

**Key positions:**

I. BCP – Ball Contact Position

II. EP – Execution Position

## Limitations

I. I. Previous training experience will not be taken into consideration.

II. II. The study's limitations will be the nutrition, healthy lifestyle choices, and way of life.

III. The body composition will not be taken into consideration.

## Hypothesis

I. From discussing the issue with subject-matter experts, consulting the literature, and using the researcher's understanding.

II. It will be hypothesized that there will be a significant relationship between kinematic variables and the performance of slap shots.

## Definition and Explanation of Terms

**Biomechanics**

Biomechanics is the study of the forces operating on the human skeleton body from the inside and the outside, as well as the consequences they have on it.

The study of how mechanical concepts relate to biological systems is known as biomechanics.

**Kinematics**

"Kinematics is branch of biomechanics about the study of human body movement with reference to the amount of the particular taken of the time to carry out the human activity". [3]

**Linear Kinematics**

For the most part, "linear kinematics deals with linear motion without taking the cause of the motion into account."

**Angular motion**

"Angular kinematics, on the other hand, only deals with angular motion or rotation; it does not investigate the origin of angular motion." [4]

## Centre of Gravity

The region where the body's apparent bulk is accumulated. The body's Centre of equilibrium is there. The area or location where the total torque of all segmental weights is zero. It functions as the Centre of the mass and the location where the body's Centre of gravity acts.[3]

The Centre of gravity of a body is the area around which its weight and mass are equally distributed in all directions.

## Slap Shot

The slap shot is an advance technique of hockey sports that comprises of the following five phases:

I. Grip and holding of the stick
II. Body position
III. Placement the ball
IV. Execution
V. Follow through

To achieve maximum distance in the minimum possible time with the help of a slap shot the player will have to balance three components - technique, speed, and force.

## Significance of Study

The study will be significant in the following ways:

I. The result of this study may help the coaches and trainees to train players.
II. The result of this study assists coaches, players, and scientists who all urgently needed further research into this problem.
III. Finally, the researcher hopes that by conducting this study, many other researchers would be inspired to try to shed more light on this particular problem.
IV. This study will help coaches and teachers to develop training programs for the maximum slap shot to achieve excellence.

## Chapter II

## REVIEW OF RELATED LITERATURE

**Keys, K. P., (2015)**, [5] A study was conduct on topic "Using principal components analysis to determine differences in ground reaction forces between high and low velocity ice hockey slap shots and wrist shots." The connection between optimal instructional techniques and athlete performance is crucial for the continued growth and popularity of ice hockey. With over 1.6 million players worldwide, it is essential for coaches and players to identify and utilize the best instructional methods to enhance athletic performance. While the mechanics of slap and wrist shots have been studied, research on ground reaction forces, particularly in the context of shooting mechanics, has been limited (Woo, 2004). As a result, many coaches rely on a "practice makes perfect" approach, emphasizing repetitive movement patterns during training to improve shooting performance and accuracy. However, this approach may overlook the need for a more scientific, kinematic-based method to ensure proper and safe mechanics. The purpose of this study was to examine the differences in ground reaction forces between high and low velocity slap and wrist shots. By doing so, the study aimed to provide evidence-based instructional strategies that could optimize the learning of shooting mechanics, ultimately improving performance on the rink. The findings highlighted the importance of adopting a more precise and scientifically grounded approach to coaching, which could lead to better, safer, and more effective practice methods for ice hockey players.

**Mally, F., (2013)**, [6] A study was conduct on topic " The kinematic analysis of the slap shot in field hockey provided valuable insights into the biomechanical principles that govern this fundamental skill" Researchers have utilized advanced motion capture technologies to explore the complex movements involved in executing a powerful slap shot (Smith et al., 2020). By meticulously tracking joint angles such as those of the knees, elbows, hips, and shoulders, alongside parameters like centre of gravity (CG) and ball velocity (BV), scientists aim to uncover the mechanical foundations that contribute to optimal performance.

**Prof. Dilip Kumar Dureha et al., (2022)**,[7] A study was conduct on topic "Two-dimensional kinematic comparison of various kicking techniques among male national-level soccer players". The kinematic analysis focused on three kicking techniques: the Full Instep Kick, Inside of the Instep Kick, and Inside of the Foot Pass. Key kinematic variables examined included hip extension, hip flexion, knee extension, knee flexion, ankle plantar flexion, ankle dorsiflexion, angle of the ankle joint, ball momentum, horizontal distance

between the kicking and non-kicking foot, total time of flight during the last stride (TTF), and total time of contact with the ball (TTC). Statistical analysis included Descriptive Statistics, One-Way Analysis of Variance (ANOVA), Independent T-tests, and Pearson Product-Moment Correlation to explore relationships between kinematic variables, anthropometric measurements, and soccer performance. Regression equations were developed using the Back ward method to predict soccer performance based on selected anthropometric and kinematic variables during the contact phase of each kicking technique. The data were analyzed using Kinovea Video Analysis Software, Silicon Coach Pro-7 motion analysis software, SPSS 17, and Microsoft Office Excel 2010. This study aimed to provide insights into the kinematic characteristics of different kicking techniques among elite male soccer players, enhancing coaching strategies and optimizing player performance.

**Seçkin, A.Ç., et al., (2023),** [8] A study was conduct on topic "Effectiveness of wearable technology in sports is multifaceted" This study depends on various factors such as the specific brand and model of the device used, as well as the context in which the technology is applied. Despite these challenges, there are compelling reasons to advocate for the use of wearables in sports settings. These devices offer potential benefits in tracking performance metrics and providing insights into athlete health and injury prevention strategies. To optimize the use of wearable technology in sports, especially for biomechanical assessments, it is crucial to tailor approaches based on the specific demands of different player positions and roles. Each position may have unique biomechanical patterns and injury risks, necessitating customized applications of wearable technology. **stuart.evans@cdu.edu.au**2022 [12] By integrating precise bio-mechanical assessments using wearable's, sports professionals can better understand the individualized needs of athletes and implement targeted strategies to enhance performance and mitigate injury risks effectively.

**Vena, A.S., (2009),** [9] A study was conduct on topic "2-dimensional kinematic analysis of the golf swing provides valuable insights into the biomechanical aspects of this fundamental movement". One significant finding from these studies is the critical role of joint angles in the golf swing technique. The angles of the hips, shoulders, wrists, and knees during the swing play a pivotal role in generating both power and accuracy. Effective coordination and timing of these movements are essential for efficiently transferring energy from the golfer to the ball, allowing for long and accurate shots. Moreover, researchers emphasize the importance of club trajectory in achieving a successful golf swing. Precise control over the club's path, facilitated by intricate wrist and forearm movements, significantly influences the

ball's flight path and speed. Golfers adept at mastering these nuances can achieve greater consistency and effectiveness in their swing executions.

**Schofield, M., (2020)**,[10] A study was conduct on topic Understanding Which Biomechanical and Neuromuscular Variables Are Important in Improving Discus, Shot Put and Hammer Throwing Performance. Auckland University of Technology. The kinematic analysis of the slap shot in field hockey provided valuable insights into the biomechanical principles that govern this fundamental skill. Researchers have utilized advanced motion capture technologies to explore the complex movements involved in executing a powerful slap shot (Smith et al., 2020). By meticulously tracking joint angles such as those of the knees, elbows, hips, and shoulders, alongside parameters like center of gravity (CG) and ball velocity (BV), scientists aim to uncover the mechanical foundations that contribute to optimal performance.

**Brown, J. W. L., et al., (2019),** [11] One significant finding from these studies highlights the "crucial role of joint angles in generating both power and precision during the slap shot". The alignment of the hips and shoulders at the moment of ball contact significantly influences the trajectory and speed of the shot. The coordination and timing of these movements are critical for maximizing energy transfer from the player to the stick and ultimately to the ball.

# Chapter III

## Research Methodology

This chapter will give an overview of the topic selection, variable of selection, criterion measures, data collection, filming methodology, film analysis, and statistical approach used for analysis.

### Selection of Subjects

30 female hockey players between the ages of 17 and 28 who participated in open national-level competitions will be the study's subjects. They are thought to possess a great level of technique. The goals of the study will be explained to the volunteers, and they will be urged to give each attempt at the study their all.

### Measurement of the Performance of Subject

The horizontal distance covered by the subjects will be used to calculate each subject's performance or score in accordance with the FIH's standard operating procedures. The horizontal distance will be measured in meters. Each subject will receive 3 trials.

### Filming Protocol and Analysis

A professional photographer who is believed to be an expert in this sector will take the study video graphs. The sagittal and frontal planes of the subject will be captured on camera. Sequential photography techniques will be used according to availability. The camera used for analysis will be Cannon 70D. At the time of the moment of execution will be at the hockey field. The photographic sequence will be taken under controlled conditions. The subject will perform this technique for each player at 3-3 chances.

### Collection of Data

The performance of all the subjects in the slap shot, filming protocol and analysis are described as under:

### Statistical Techniques

Slap shot regression analysis will be used to compare a set of chosen kinematic variables to determine how they differ from one another. The testing hypothesis the level of significance will be at the level of 0.05.

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